# Sediment Quality Guidelines for Wetland Creation in San Francisco Bay

Stakeholder Workshop

DMMO

November 14, 2002

| Time | Topic | Process | Presenter/Leader |
|---|---|---|---|
| **1:30-1:35** | Welcome to Workshop | | Tom Gandesbery<br>Coastal Conservancy |
| **1:35-1:45** | Review of purpose of workshop and desired outcomes | Presentation and Q&A | G & A Team<br>Drew Carey |
| **1:45-2:00** | Sediment testing and screening guidelines – relevance to beneficial reuse | Presentation and Q&A | G & A Team<br>Drew Carey |
| **2:00-2:30** | Evaluation procedures for assessment of guidelines – predictive accuracy | Presentation and Q&A | G & A Team<br>Lorraine Read |
| **2:30-2:40** | Break | | |
| **2:40-2:50** | Database content – proposed database for screening guidelines | Presentation and Q&A | G & A Team<br>Peggy Myre |
| **2:50-3:20** | Application of screening guidelines to beneficial reuse – issue identification | Group discussion | G & A Team<br>Drew Carey |
| **3:20-3:30** | Summarize project approach and record feedback from stakeholders | Group discussion and consensus | Drew Carey<br>&<br>DMMO Host |

# Goals of Workshop

- Stakeholder contribution to design of SQGs
- Review basis for project
- Review sediment testing and guidelines
- Review approaches to assessment
- Review data sources and limitations
- Identify issues and concerns
- Summarize feedback on approach

# Project Basis

- Funding from Coastal Conservancy
- Evaluate SQG for wetland restoration and beneficial reuse based on regional data
- Review screening approaches
- Assemble and review potential database
- Present approach to DMMO and stakeholders
- Perform analysis and propose guidelines

# Purpose of SQGs for Wetland Restoration

- Sediment Quality Guidelines = SQGs
- Protection of the marine/wetland environment
- Establish screening values to be used by DMMO when evaluating the suitability of dredged material for wetland restoration and beneficial reuse.
- To make *appropriate use* of dredged sediments in the creation of wetlands

# Why are they necessary?

- Guidelines a goal of LTMS
- Proposed guidelines (RWQCB 1992 & 2000) defaulted to national guidelines & ambient
- Desire to establish guidelines based on SF Bay conditions
- Need guidance to help meet 40% beneficial reuse target (LTMS 40:40:20)
- Guidelines can help DMMO and applicants to focus on solutions for “problem” sediments

# Beneficial Reuse

- Habitat development
  - Tidal wetlands
    - Cover – assume contact with environment
    - Foundation – assume no direct contact with environment
- Levee maintenance
- Construction fill
- Daily landfill cover

# Sediment Testing and Screening Guidelines

Germano and Associates Team

# Testing and Screening Guidelines

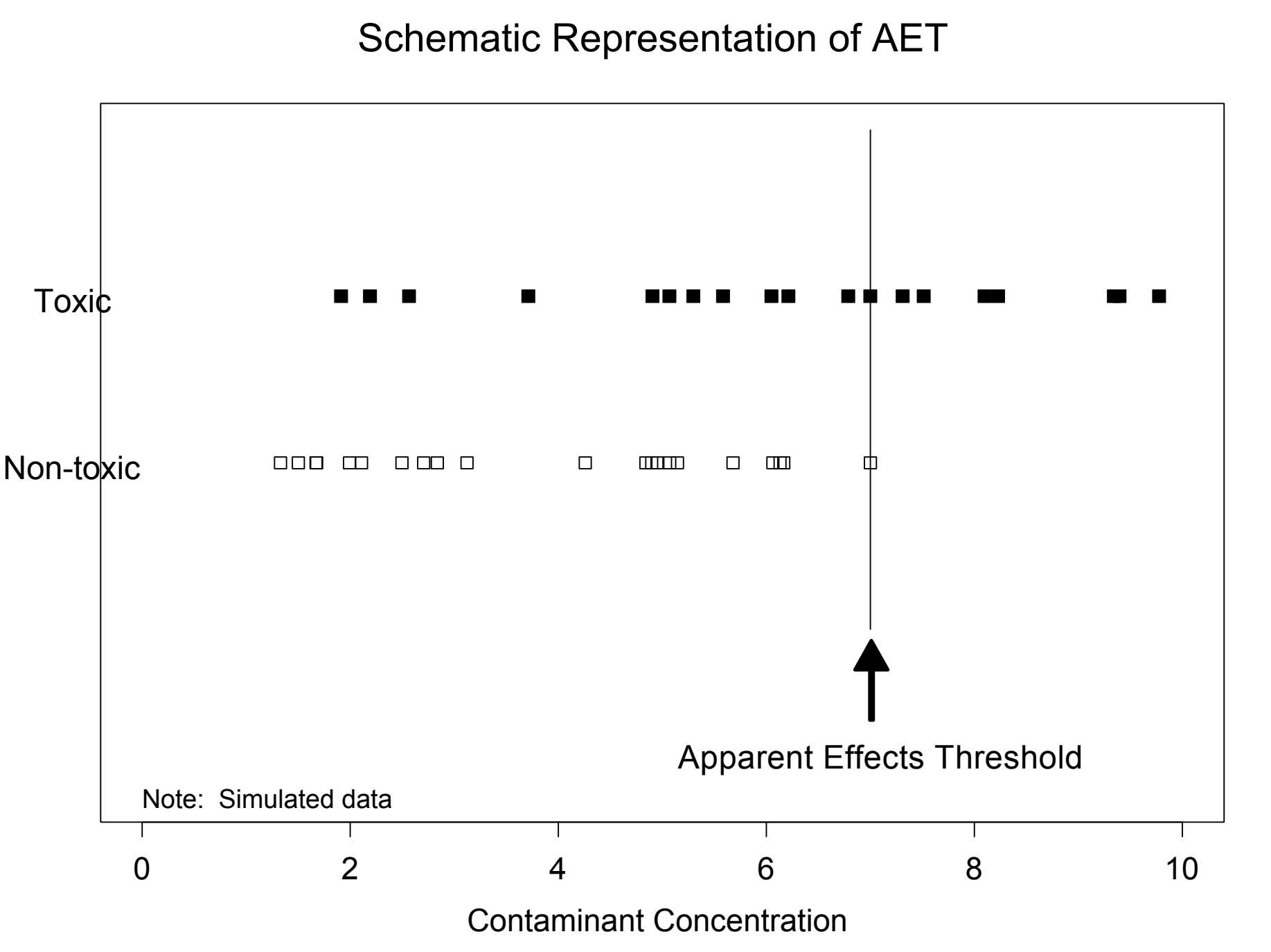
| Environment | Exposure | Chemistry test | Bioassay test(s) | Leachate chemistry | Screening<br>1) Chemistry<br>2) Toxicity<br>3)Leachate |
|---|---|---|---|---|---|
| Wetland surface (cover) | Direct exposure | Sediment chemistry | Two benthic species; three life history stages | None | 1)Ambient or ER-Ls<br>2)no sig. Tox<br>3)not applicable |
| Foundation, Levees, and construction fill | Unlikely direct exposure;<br>Leachate on-site | Sediment chemistry | None | Modified WET | 1)ER-Ms or PELs<br>2) Not applicable<br>3) Basin plan WQO's |
| Landfill daily cover | No exposure | Testing and acceptability criteria specific to each landfill, contact individual landfills for requirements | | | |
| Dewatering discharges | Receiving waters | Elutriate chemistry | One species sediment elutriate | Not applicable | 1)Basin plan WQO's<br>2) No sig. Tox.<br>3) Not applicable |

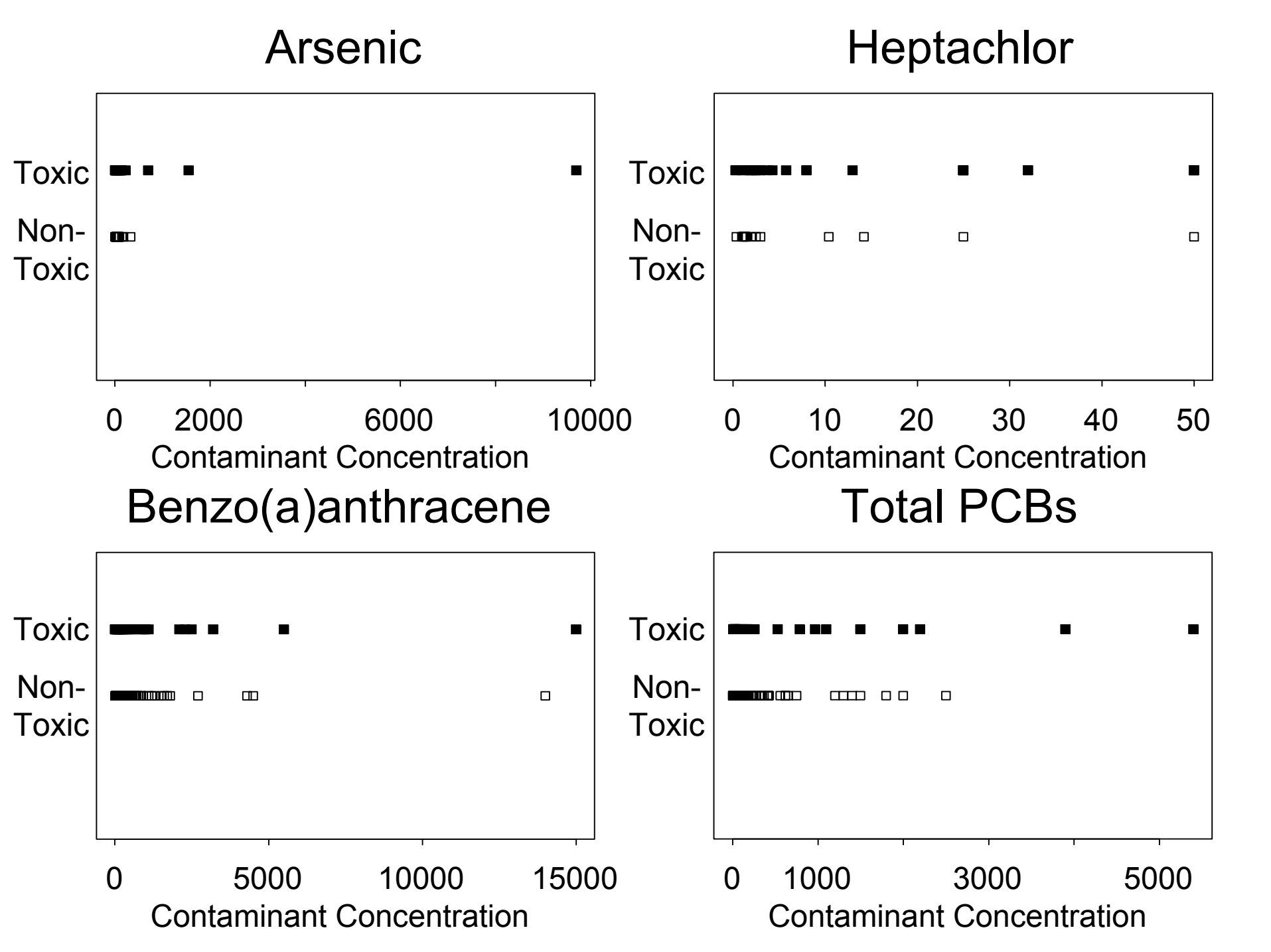
# Sediment Testing

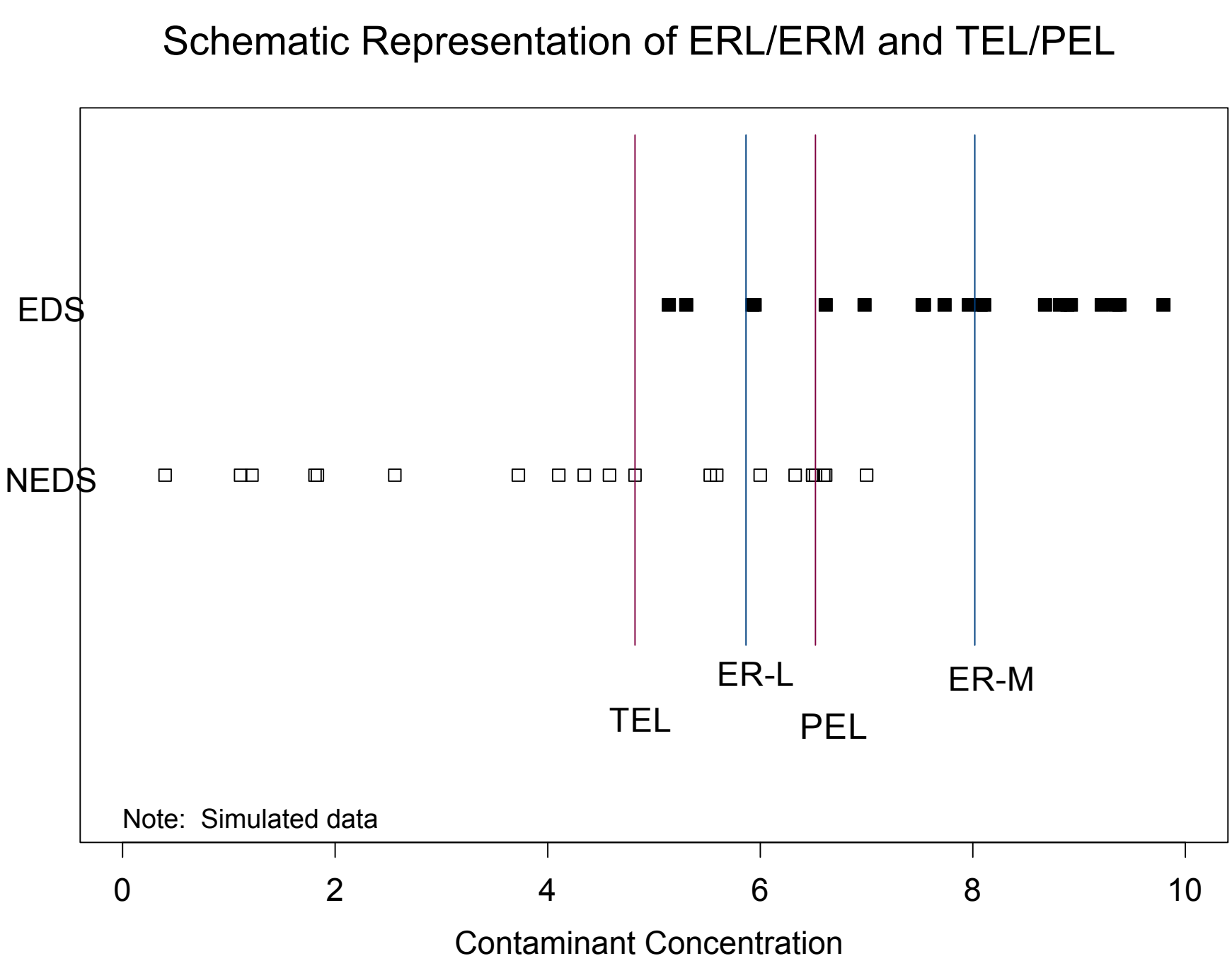
- Protocol: compare to reference sediments
  - Public Notice 01-01, 99-4
  - Inland Testing Manual, Green Book
- Sediment chemistry – bulk sediment
- Acute toxicity – 10 day amphipod test
- Other tests (e.g., elutriate) may be required but majority of data based on acute toxicity

# Empirical Approaches for Deriving SQGs

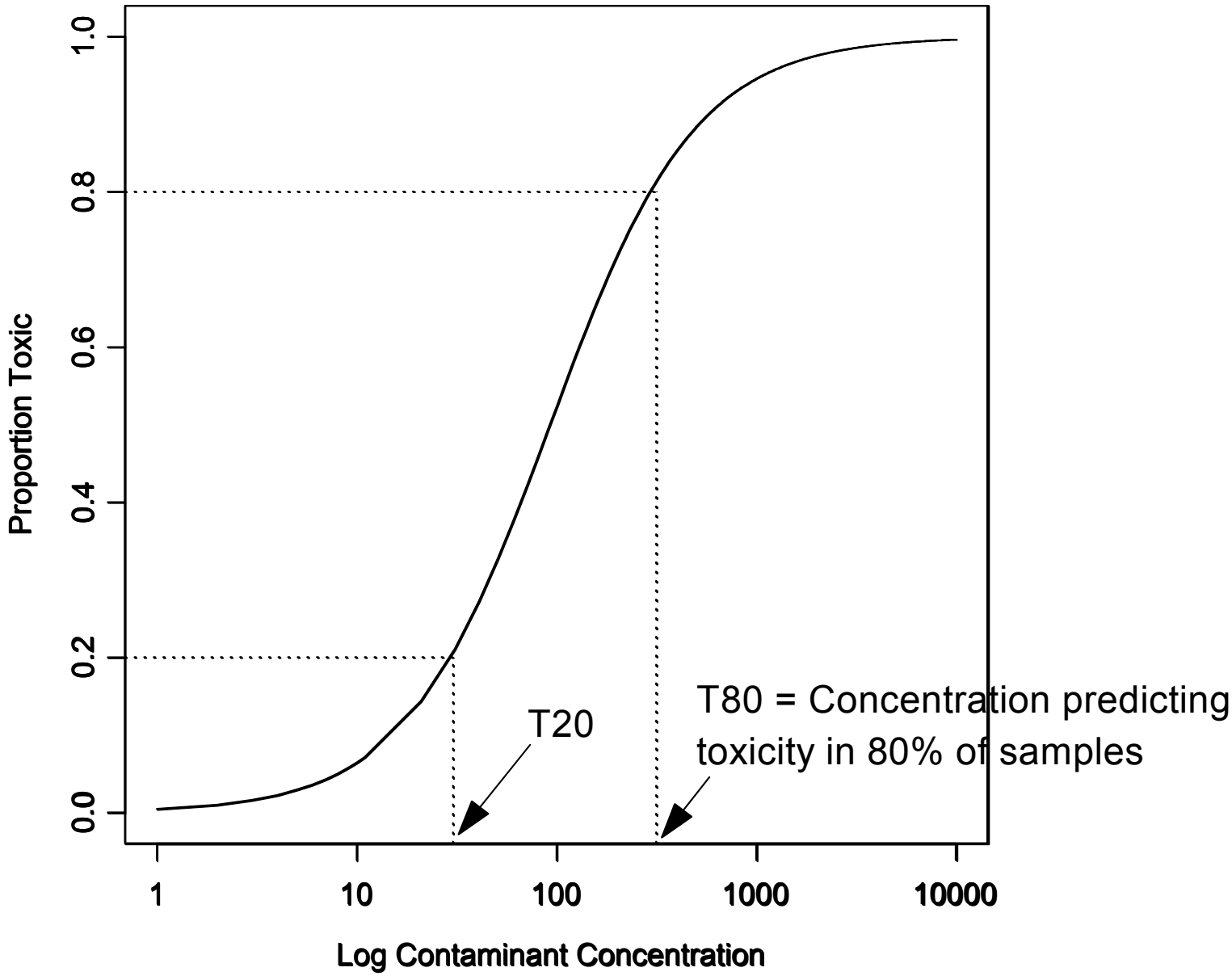
- Apparent Effects Thresholds (AETs)
- Screening and Maximum Levels (SL/ML)
  (PSDDA iteration of AETs)
- Effects Range Low and Median (ERL/ERM)
- Threshold and Probable Effects Levels (TEL/PEL)
- Logistic Regression Models (LRM)
- Floating Percentile (FP)


Schematic Representation of AET
Toxic
Non-toxic
Apparent Effects Threshold
Note: Simulated data
0
2
4
6
8
10
Contaminant Concentration


Arsenic
Toxic
Non-
Toxic
0
2000
6000
10000
Contaminant Concentration
Heptachlor
Toxic
Non-
Toxic
0
10
20
30
40
50
Contaminant Concentration
Benzo(a)anthracene
Toxic
Non-
Toxic
0
5000
10000
15000
Contaminant Concentration
Total PCBs
Toxic
Non-
Toxic
0
1000
3000
5000
Contaminant Concentration


Schematic Representation of ERL/ERM and TEL/PEL
EDS
NEDS
TEL
ER-L
PEL
ER-M
Note: Simulated data
0
2
4
6
8
10
Contaminant Concentration

# Logistic Regression Model



# Limitations Common to all SQG Derivation Methods

Chemical specific SQGs do not:

- *address unanticipated chemicals or those for which values have not been developed*
- *address the interaction of chemicals (synergistic or antagonistic)*
- *necessarily bear any relevance for geographic regions or environments other than those for which they were developed*
- *produce consistent results*

# Evaluation of guidelines

Lorraine Read

Germano and Associates Team

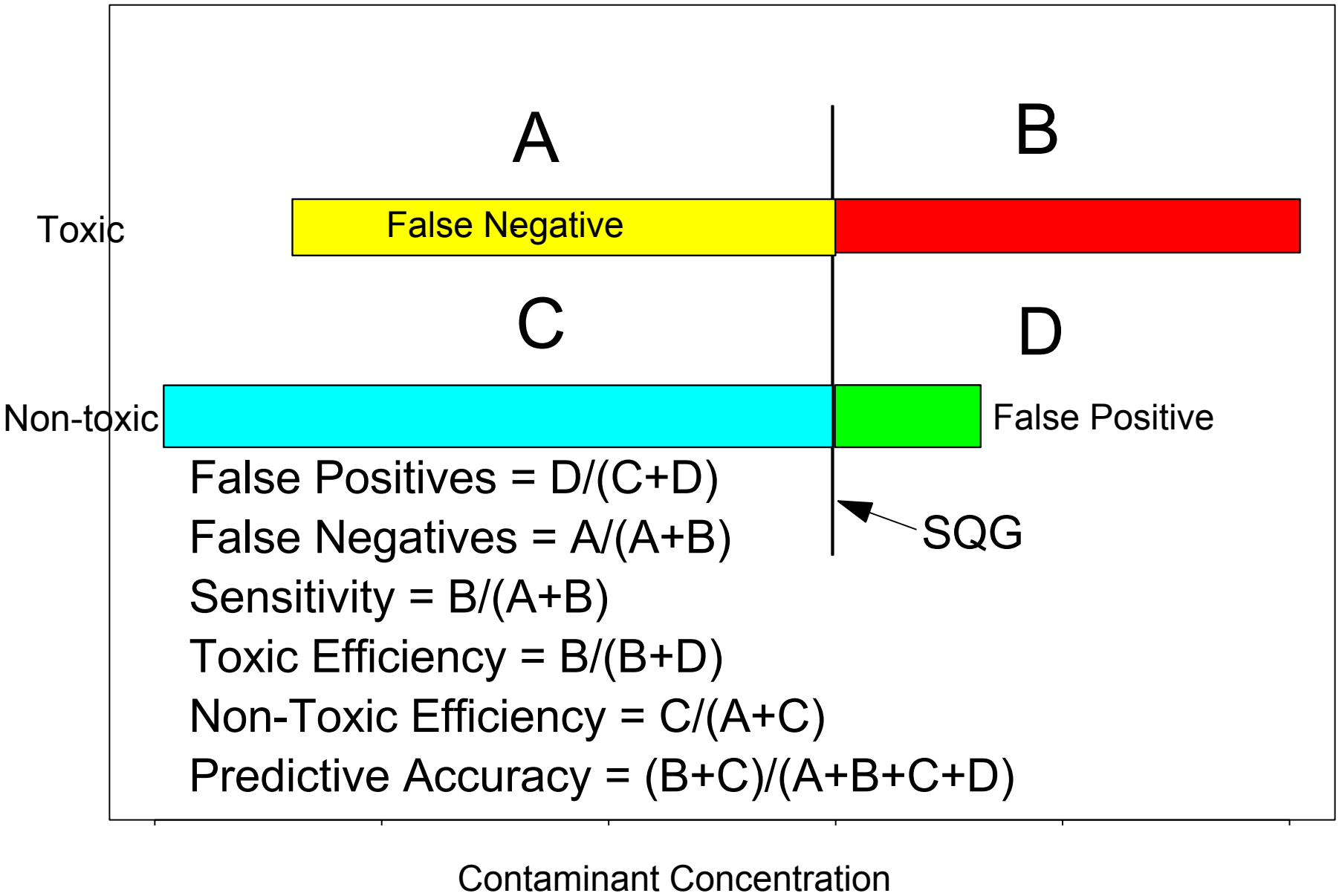
# Evaluation Approach

- Review Existing Guidelines
  - Determine set that can be evaluated
- Define Terms
- Review Evaluation Approach
  - Quantify False Negatives
  - Quantify False Positives
  - Quantify accuracy of prediction of lack of toxic responses
- Assess SQG against objectives
- Propose Wetland guidelines

# Reliability Assessment Tools

- **False positives**: the percent of non-toxic samples that were predicted to be toxic
- **False negatives**: the percent of toxic samples that were not predicted to be toxic
- **Sensitivity**: the percent of toxic samples that were predicted to be toxic
- **Efficiency**: the percent of samples predicted to be toxic that were toxic (non-toxic predictions, also)
- **Predictive Accuracy**: the percent of samples that were correctly predicted (both toxic and non-toxic)

# Schematic for Reliability Calculations



# Definitions Required:

- "Toxic"

  Amphipod mortality endpoint, only

  Statistical comparisons to Reference "Envelope"

  (range of Reference area responses)

- Predicted to be toxic

  Exceeds guideline for at least one chemical or

  Mean SQG "quotient" > threshold *

- Predicted to be non-toxic

  No exceedances for any chemicals or

  Mean SQG "quotient" < threshold *

* Threshold selected to achieve defined predictive accuracy

# Program objectives: to make *appropriate use* of dredged sediments in the creation of wetlands around San Francisco Bay

| Definitions | Cover | Foundation |
|---|---|---|
| **"appropriate use"** | Sediments are ***predicted*** to pose ***minimal risk*** to environment through direct exposure* | Sediments are ***predicted*** to pose a ***limited risk*** to the environment for possible routes of exposure* |
| **"predicted"** | A specific fraction of the samples collected from dredging area have the mean SQG quotient below a **lower** threshold | A specific fraction of the samples collected from dredging area have the mean SQG quotient between a **lower** threshold and a **upper** threshold |
| **"minimal risk"** | The prediction definition has been tested and meets a target false negative error rate (e.g., 10%) | N/A |
| **"limited risk"** | N/A | The prediction definition has been tested and meets a target false negative error rate (e.g., 30%), and exceedances of the upper threshold achieves a target sensitivity (e.g., 50%) |

*Amphipod toxicity is only surrogate for "risk to environment" because of data and method limitations

# Objectives and Definitions Differ for Cover and Foundation Materials

**Cover**: sediments predicted to pose *minimal risk* to benthic invertebrates through direct exposure.

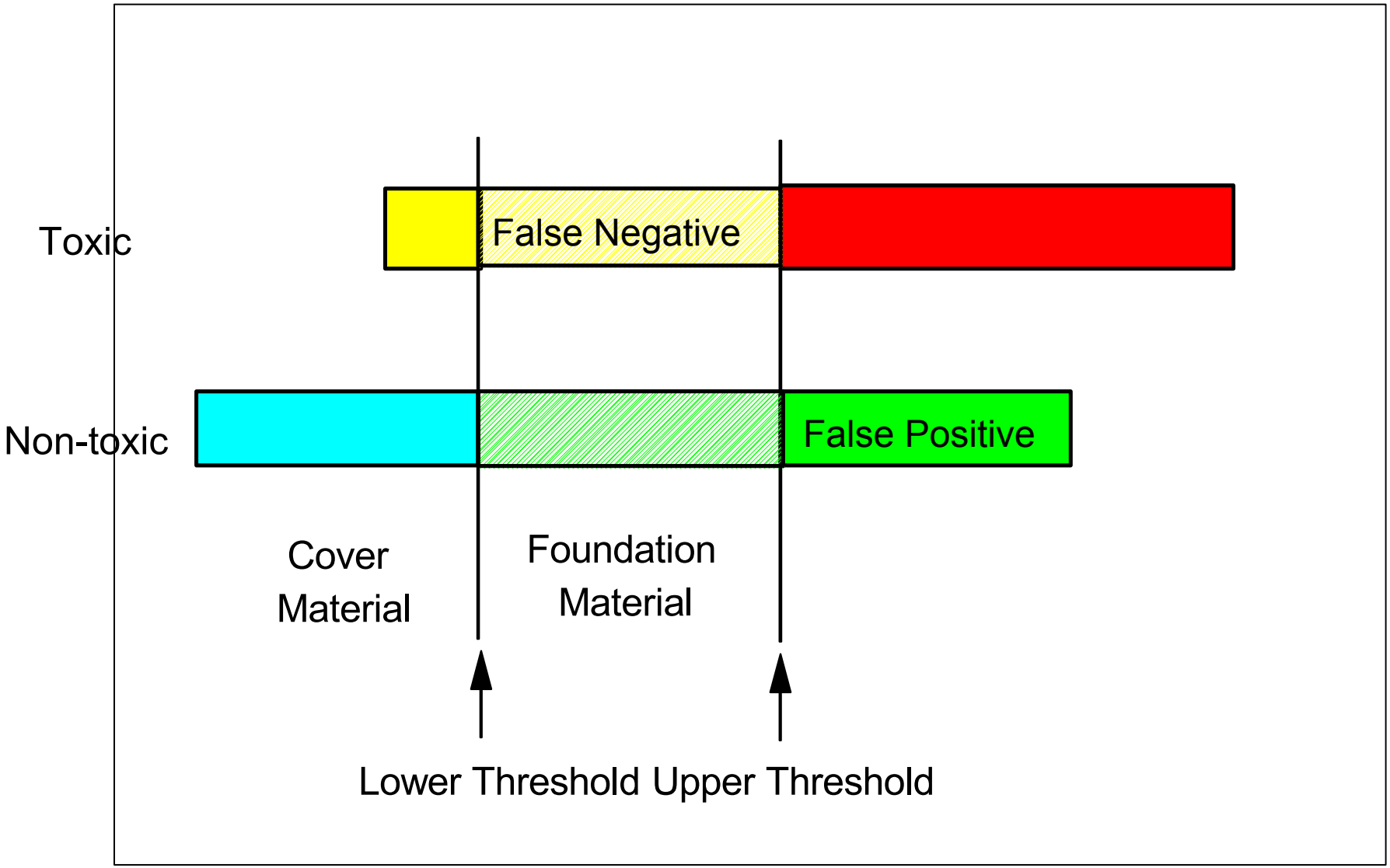
- "Minimal risk" defined: the prediction definition has been tested and meets a low target false negative error rate (e.g., 10%)

# Objectives and Definitions Differ for Cover and Foundation Materials

**Foundation**: sediments predicted to pose *limited risk* to environment for possible routes of exposure.

- "Limited risk" defined: the prediction definition has been tested and meets a moderate target false negative rate (e.g., 30%) and moderate sensitivity (e.g., 50%)

# Schematic for Cover and Foundation Target Rates



# Summary of Approach

- Define:
  - toxic/non-toxic status
  - toxic/non-toxic predictions
  - target reliability and error rates for cover and foundation materials separately
- Evaluate reliability of existing SQGs
  - compare to base rates (% of toxicity in Bay)
  - compare to target rates (predictive accuracy)
- Assess the need for site-specific SQGs

# Site-Specific SQGs (if necessary)

- AETs or PAETs
- Floating Percentile
- Reference Envelope of Chemistry (random tolerance intervals for reference area concentrations)

  (Smith and Riege, 1999. San Francisco Bay Sediment Criteria Project, Report to RWQCB)

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# Database Content

Peggy Myre
Germano and Associates Team

# Database Content

- 623 Paired Sediment Chemistry/Bioassay Samples (to date)
- Dredging and Monitoring Data
  - >900 Monitoring Samples (BPTCP/RMP)
  - >200 Dredging Samples
- Data
  - Almost all have TOC and grain size
  - Include reference area data

# Data Content, continued

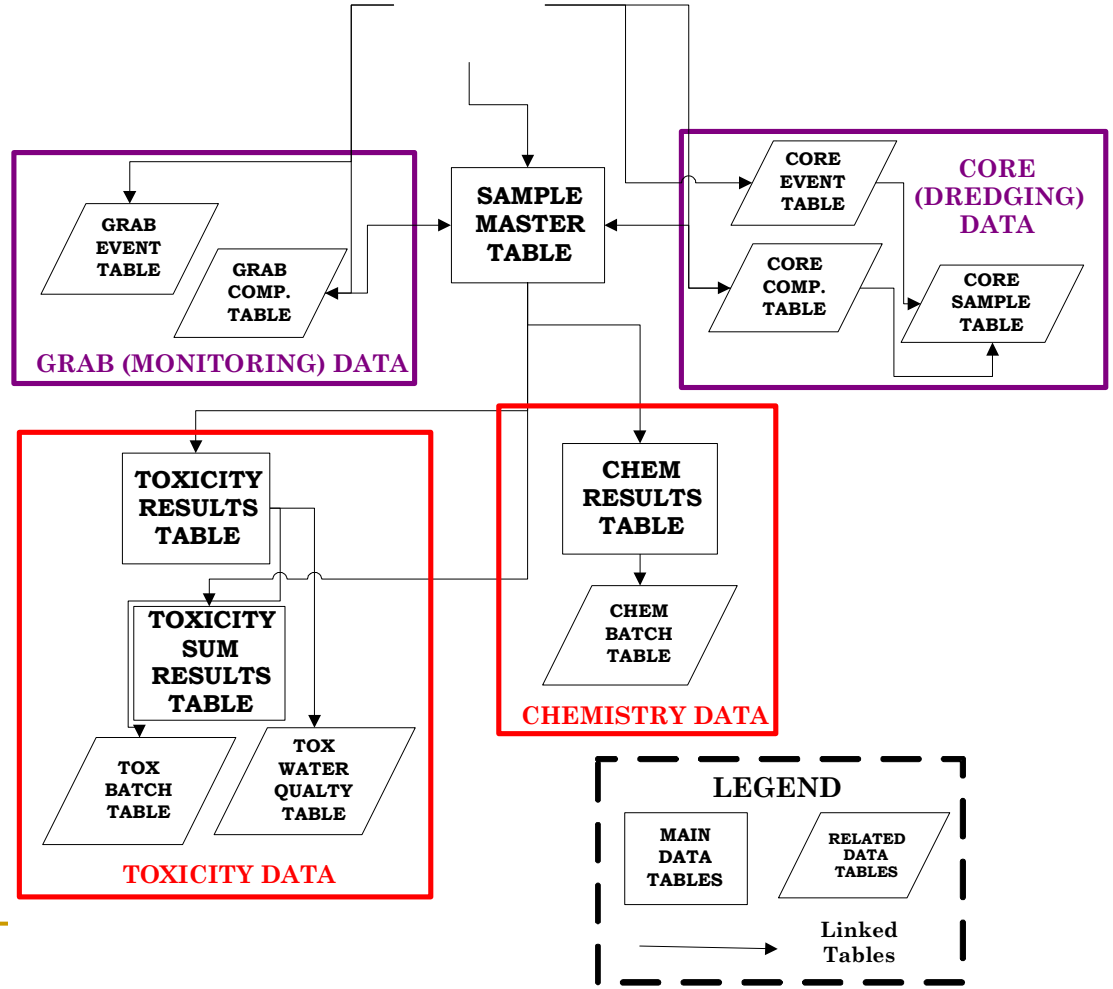
- Sediment Chemistry Data
  - PAHs, Pesticides
  - TBTs, Metals
  - PCBs (both congeners and aroclors)
- Bioassay Tests
  - Elutriate
  - Pore Water
  - Sediment – will use acute toxicity results

# Database Struc

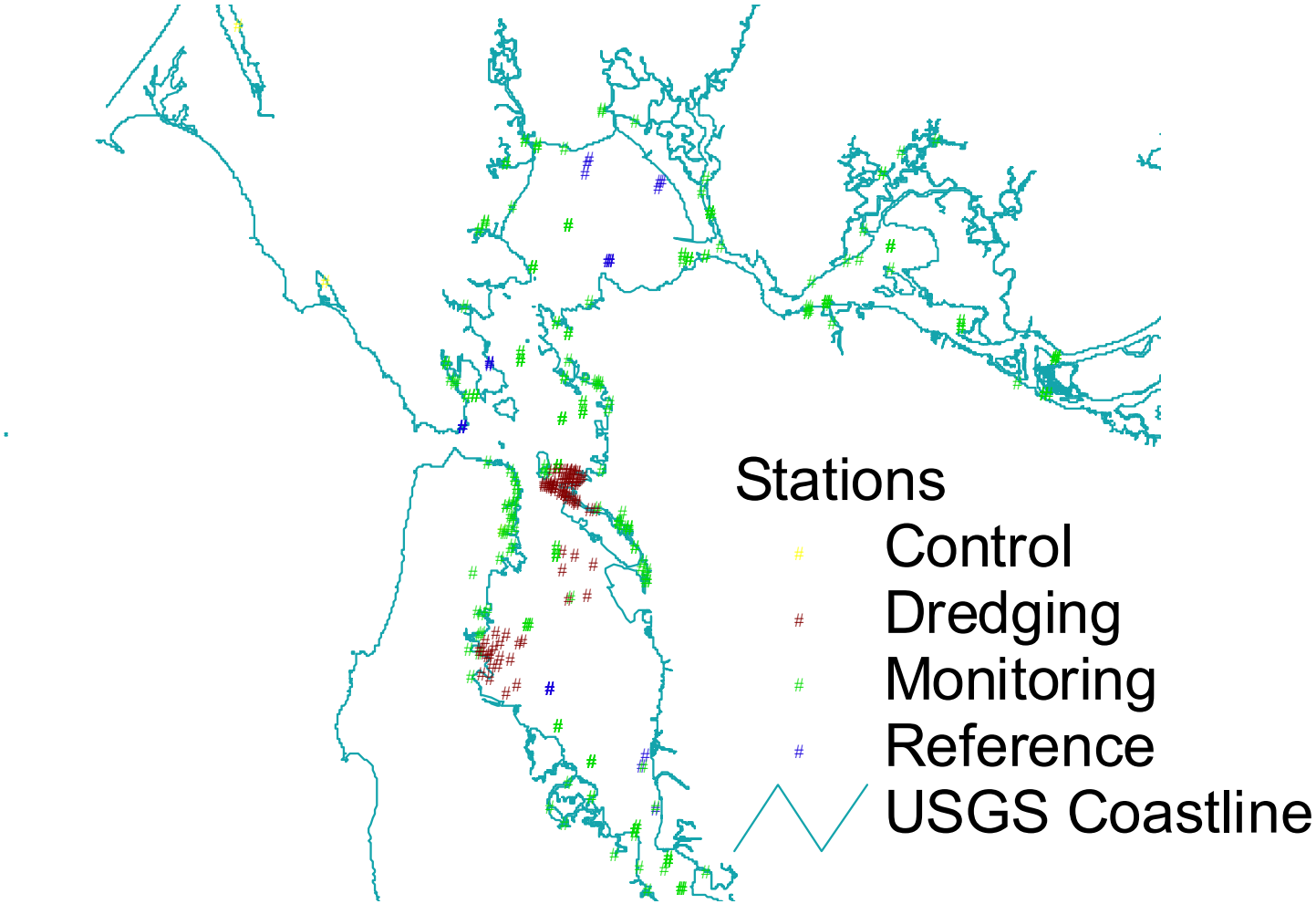
- Monitoring Data
- Dredging Project Data

**TABLES**

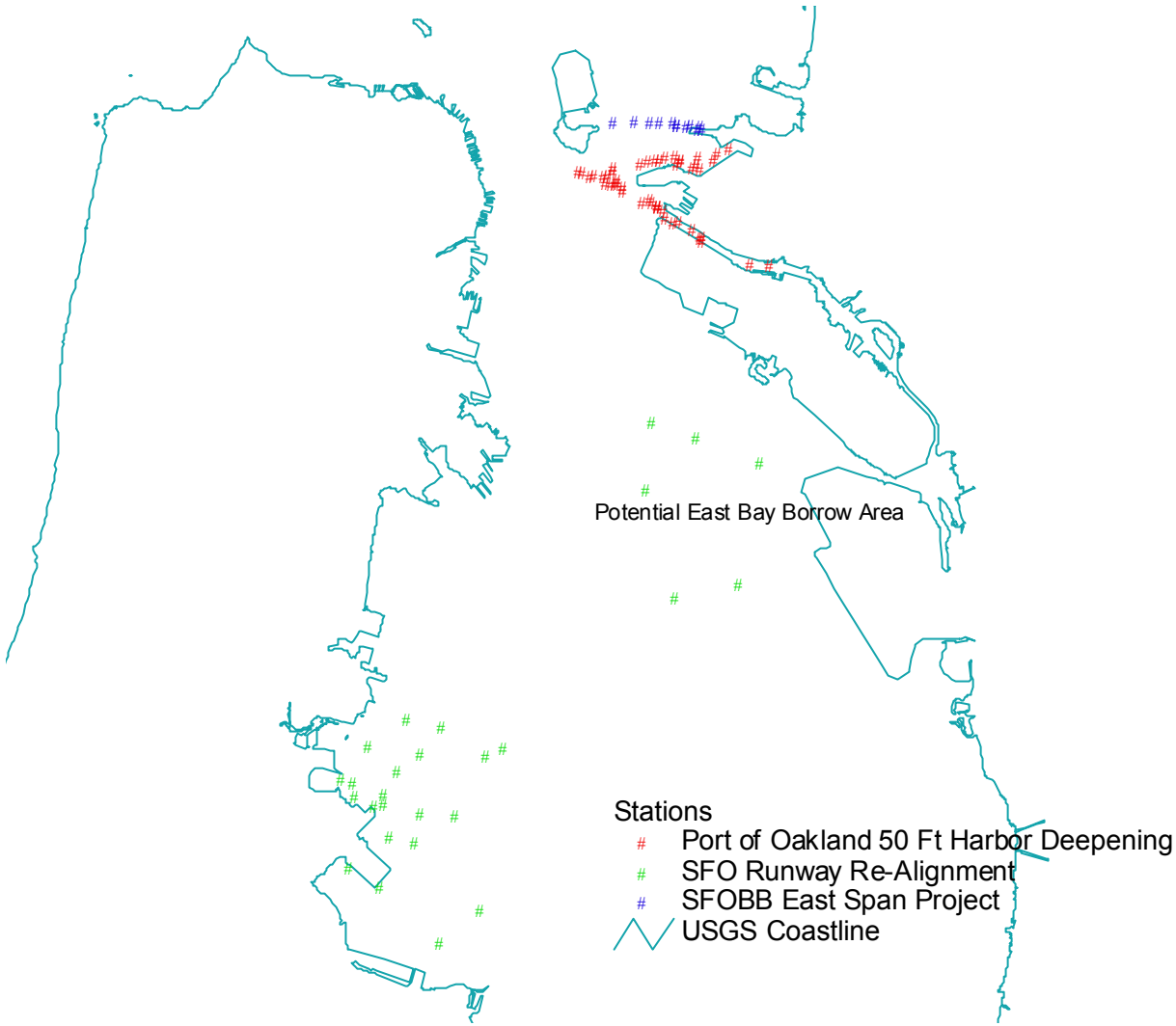
- STUDY
- STATION
- SAMPLING
- DATA



# Station Types



# Dredging Studies



# Summary of Amphipod Data

| Study Name | Station Type | Ampelisca abdita | Eohaustorius estuarius | Rhepoxynius abronius |
|---|---|---|---|---|
| BPTCP 1994/95 Reference Site Survey | Monitoring | 3 | 3 | |
| | Reference | 43 | 48 | |
| BPTCP 1995 Screening | Monitoring | | 86 | |
| | Reference | | 4 | |
| BPTCP 1997 Confirmation | Monitoring | | 23 | |
| | Reference | | 2 | |
| BPTCP 1997 Screening (Stege Marsh) | Monitoring | | 7 | |
| | | | | |
| RMP 1993 Regional Monitoring Program | Monitoring | | 14 | |
| | Reference | | 2 | |
| RMP 1994 Regional Monitoring Program | Monitoring | | 18 | |
| | Reference | | 4 | |
| RMP 1995 Regional Monitoring Program | Monitoring | | 19 | |
| | Reference | | 4 | |
| RMP 1996 Regional Monitoring Program | Monitoring | | 22 | |
| | Reference | | 4 | |
| RMP 1997 Regional Monitoring Program | Monitoring | | 24 | |
| | Reference | | 4 | |
| RMP 1998 Regional Monitoring Program | Monitoring | | 25 | |
| | Reference | | 4 | |
| RMP 1999 Regional Monitoring Program | Monitoring | | 12 | |
| | Reference | | 2 | |
| | | | | |
| Port of Oakland 50 Ft Harbor Deepening | Dredging | 67 | | |
| SFO Runway Re-Alignment | Dredging | 50 | 55 | |
| | Reference | 15 | 18 | |
| SFOBB East Span Project | Dredging | 12 | | |
| | Reference | 4 | | |
| USACE San Pablo Reference Area Data | Reference | | | 3 |
| **Total Number of Amphipod Samples** | | **194** | **404** | **3** |

*Excludes SF-DODS

# Determination of Toxicity

- Comparison to published reference values
  - Alcatraz Environs
- Comparison to reference, batch-specific
- Comparison to negative control
- Comparison to defined threshold
  - Thursby et al.
- *Comparison to reference envelope (tolerance limits)*
  - Hunt et al. 1998

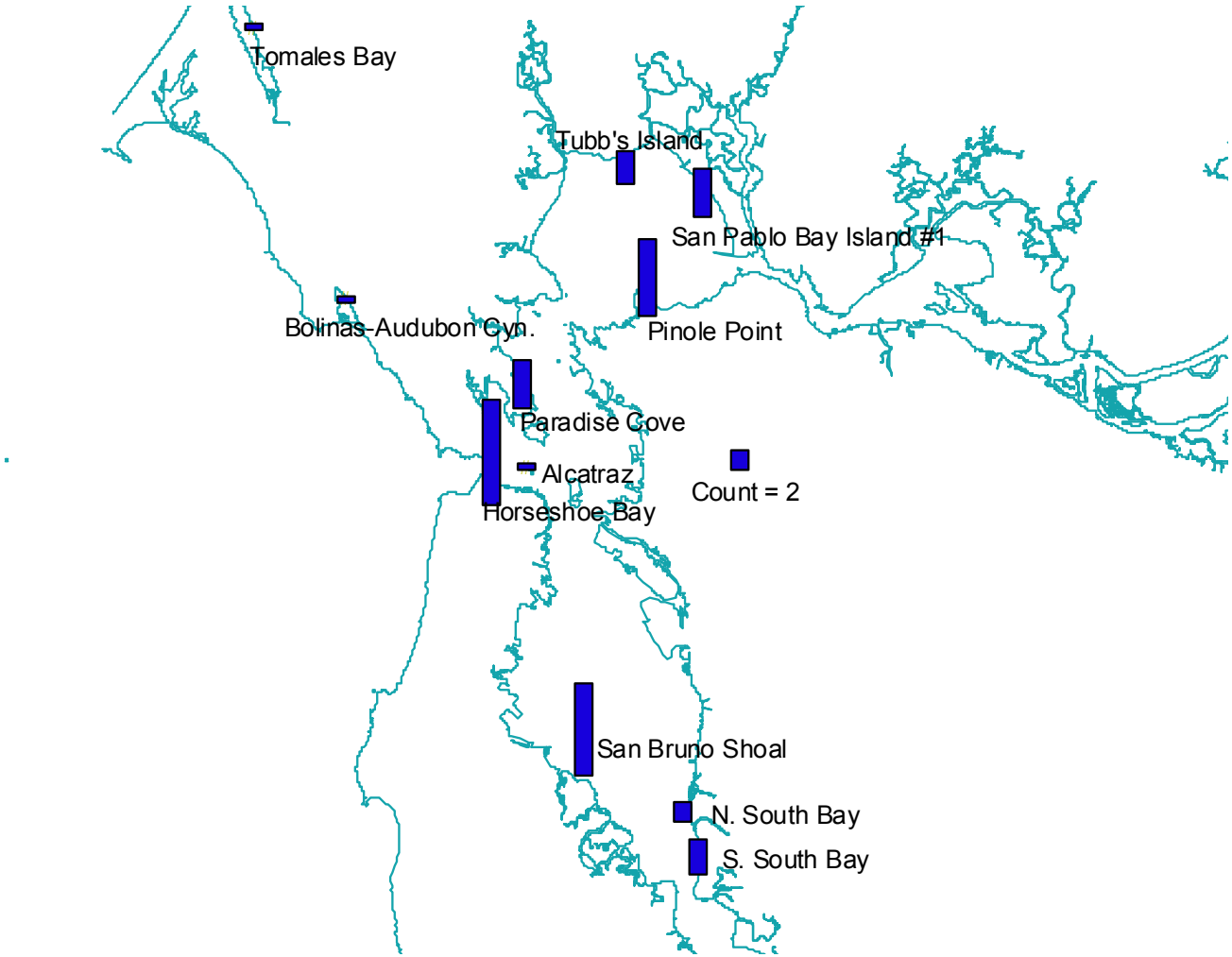
# Advantages of the Reference Envelope Approach

- Precedence in the region
  - Tolerance limits developed in BPTCP Hunt et al., 1998 study
- Sufficient data
- Allows stratification by grain size
- Minimizes influence of spatial and temporal variation

# Reference Issues

- Selection of appropriate reference areas
- Screening data for inappropriate chemistry values
  - Comparison to guideline quotient means
  - Removal of outliers
- Screen data by quality control
  - Control response
  - Water quality
  - Confounding factors

# Reference Station Visits



# Reference Area Data

- Reference area definition
  - Minimal impact from anthropogenic activities
  - Similar physical properties to samples under consideration
- Data
  - BPTCP reference area surveys (94-95)
  - RMP (selected stations)
  - Dredging studies

# Reference Area Toxicity Samples

| Reference Area | Ampelisca abdita | Eohaustorius estuarius | Rhepoxynius abronius |
|---|---|---|---|
| Alcatraz | 1 | | |
| San Pablo Bay Island #1 | 9 | 11 | 3 |
| Bolinas-Audubon Cyn. | 3 | 4 | |
| Horseshoe Bay | | 11 | |
| N. South Bay | 3 | 5 | |
| Paradise Cove | 10 | 12 | |
| Pinole Point | | 4 | |
| S. South Bay | 8 | 11 | |
| San Bruno Shoal | | 9 | |
| San Pablo Bay Island #1 | 9 | 11 | |
| SF-DODS | 6 | 6 | |
| Tomales Bay | 7 | 7 | |
| Tubb's Island | 15 | 16 | |
| | | | |
| Total Number of Samples | 71 | 107 | 3 |

# Additional concerns

- Are stakeholder interests represented?
- Is it clear how guidelines would be used?
- What is relationship to statewide guidelines?
- Potential limitations on project and results